FORM PTO-1390 (Modified) (REV 10-95) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **2867-0187-2 PCT**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): **09/529429**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/SE98/01973	**30 October 1998**	**03 November 1997**

TITLE OF INVENTION

IMPROVEMENTS IN, OR RELATING TO, DIGITAL TRANSMISSION

APPLICANT(S) FOR DO/EO/US

Gunnar BAHLENBERG, et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 18 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
    A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☐ Certificate of Mailing by Express Mail
19. ☒ Other items or information:

Request for Consideration of Documents Cited in International Search Report
Notice of Priority
PCT/IB/304
PCT/IB/308

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/529429	PCT/SE98/01973	2867-0187-2 PCT

20. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Search Report has been prepared by the EPO or JPO	**$840.00**
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482)	**$670.00**
☐	No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))	**$760.00**
☒	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO	**$970.00**
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)	**$96.00**

ENTER APPROPRIATE BASIC FEE AMOUNT =	**$970.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$130.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	26 - 20 =	6	x $18.00	**$108.00**	
Independent claims	2 - 3 =	0	x $78.00	**$0.00**	
Multiple Dependent Claims **(check if applicable).**			☐	**$0.00**	
TOTAL OF ABOVE CALCULATIONS			=	**$1,208.00**	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable).**			☐	**$0.00**	
SUBTOTAL			=	**$1,208.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			+	**$0.00**	
TOTAL NATIONAL FEE			=	**$1,208.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).**			☐	**$0.00**	
TOTAL FEES ENCLOSED			=	**$1,208.00**	
				Amount to be: refunded	$
				charged	$

☒ A check in the amount of **$1,208.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **15-0030** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

OBLON, SPIVAK, McCLELLAND, MAIER & NEUSTADT, P.C.
Crystal Square Five, Fourth Floor
1755 Jefferson Davis Highway
Arlington, Virginia 22202
703-413-3000

WILLIAM E. BEAUMONT
REGISTRATION NUMBER 30,996

SIGNATURE

Marvin J. Spivak
NAME

24,913
REGISTRATION NUMBER

May 3, 2000
DATE

2867-0187-2 PCT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF: :

GUNNAR BAHLENBERG ET AL : ATTN: APPLICATION DIVISION

SERIAL NO: NEW U.S. PCT APPLN :
(Based on PCT/SE98/01973)

FILED: HEREWITH :

FOR: IMPROVEMENTS IN, OR RELATING TO, DIGITAL TRANSMISSION

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Prior to a first examination on the merits, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, before line 1, insert

--TITLE OF THE INVENTION--;

between lines 1 and 2, insert

--BACKGROUND OF THE INVENTION

Field of the Invention--;

between lines 4 and 5, insert

--Discussion of the Background--.

Page 2, between lines 6 and 7, insert

--SUMMARY OF THE INVENTION--.

Page 4, between lines 13 and 14, insert

--BRIEF DESCRIPTION OF THE DRAWINGS--;

between lines 17 and 18, insert

--DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

IN THE CLAIMS

Please amend the claims as follows:

Claim 2, line 1, change "2" to --1--.

Claim 3, line 1, delete "either"; same line, delete "or claim 2,".

Claim 4, line 1, delete "either"; same line, delete "or claim 3,".

Claim 5, line 1, delete "or claim 4,".

Claim 6, line 1, change "any of claims 2 to 5," to --claim 2,--.

Claim 7, line 1, change "any of claims 2 to 6," to --claim 2,--.

Claim 8, line 1, change "any previous claim," to --claim 1,--.

Claim 9, line 1, change "any previous claim," to --claim 1,--.

Claim 10, line 1, change "any previous claim," to --claim 1,--.

Claim 11, line 1, change "any previous claim," to --claim 1,--.

Claim 12, line 1, delete "either"; same line, delete "or claim 11,".

Claim 13, line 1, "any of claims 10 to 12," to --claim 10,--.

Claim 16, line 1, delete "either"; same line, delete "or claim 15,".

Claim 17, line 1, delete "either"; same line, delete "or claim 16,".

Claim 18, line 1, delete "or claim 17 when dependent on claim 15,".

Claim 19, line 1, change "any of claims 15 to 18," to --claim 15,--.

Claim 20, line 1, change "any of claims 15 to 19," to --claim 15,--.

Claim 21, line 1, change "any of claims 14 to 20," to --claim 14,--.

Claim 22, line 1, change "any of claims 14 to 21," to --claim 14,--.

Claim 23, line 1, change "any of claims 14 to 22," to --claim 14,--.

Claim 24, line 1, change "any of claims 14 to 22," to --claim 14,--.

Claim 25, line 1, delete "either"; same line, delete "or claim 24,".

Claim 26, line 1, change "any of claims 23 to 25," to --claim 23,--.

IN THE ABSTRACT

Please delete the original abstract sheet in its entirety and insert therefor

--ABSTRACT OF THE DISCLOSURE

A digital transmission system and method which combines advantages of OFDD with Frequency Divided Duplex (FDD), to thereby enable a reach of a vdsl transmission system to be extended. The system and method require utilizing an extra cyclic prefix and, for longer lines, frequencies above the FDD band are not used. As a result, time synchronization is performed between all transmitters in the ONUs and the NTs, a timing advance is calculated from a line length, and different sub-carriers are used in up-stream and down-stream directions.--

REMARKS

Favorable consideration of this application, as presently amended, is respectfully requested.

The present preliminary amendment is submitted to place the above-identified application in more proper format under United States practice. By the present preliminary amendment the specification has been amended to include suggested headings. The claims have been amended to no longer recite any multiple dependencies. A new abstract believed to be in more proper format under United States practice is also submitted herein.

The present application is believed to be in condition for a full and thorough examination on the merits. An early and favorable consideration of the present application is hereby respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

Gregory J. Maier
Attorney of Record
Registration No. 25,599
Surinder Sachar
Registration No. 34,423

Crystal Square Five - Fourth Floor
1755 Jefferson Davis Highway
Arlington, Virginia 22202
(703) 413-3000
Fax No.: (703) 413-2220
SNS/cle
I:\atty\SNS\28670187.pr

Improvements in, or Relating to, Digital Transmission

The present invention relates to digital transmission systems employing VDSL and/or ADSL with reduced NEXT, and methods of transmitting data with reduced NEXT using VDSL and/or ADSL.

Current proposals for the use of VDSL (Very high rate Digital Subscriber Line) suggest that it should be limited to a maximum range of 1.5 Km. Most telecommunications operators have access networks where a 1.5 km transmission range would mean that many subscribers are excluded from receiving service. If VDSL is to be offered on a universal, or near universal basis, subscriber lines need to be shortened. This would be a prohibitively expensive operation demanding the wholesale reconstruction of telecommunications networks. Instead of shortening subscriber lines it may be desirable to offer subscribers the transmission capacity that is available on the lines they currently possess. This kind of graceful degradation in capacity means that the reach of VDSL can be extended. The present invention describes a technique for extending the reach of VDSL without degrading the transmission capacity of shorter lines.

There are two different kind of cross-talk for wire communication, cross-talk in the Near- End (NEXT) and in the Far-End (FEXT). NEXT is the more damaging form of cross-talk, so it is desirable to design systems that suppress NEXT. With a smart duplex scheme it is possible to minimise NEXT between VDSL Systems. The duplex technique disclosed in our patent application PCT/SE 9600935 is intended to suppress NEXT. Using this technique it is possible to use any carrier for either the up-stream, or down-stream, transmission direction. This method is known as OFDD (Orthogonal Frequency Divided Duplex), also known as Zipper. The elements of OFDD are:

- different sub-carriers are used in the up-stream and down-stream transmission directions;

- time synchronisation is performed between all transmitters in the

ONUs and the NTs; and

- an extension of the cyclic prefix is added to compensate for delay propagation.

Related to NEXT, is near end echo produced in balanced hybrids. Our co-pending patent application Kgp 151/97 describes a hybrid circuit which substantially suppresses near end echo.

According to a first aspect of the present invention, there is provided a telecommunications system having a plurality of data modems linked to a central station by subscriber lines of differing lengths, in which duplex data is transmitted between said central station and one, or more, modems using VDSL, said subscriber lines being grouped into longer and shorter lines, characterised in that FDD is employed at lower frequencies for transmissions over said longer lines and OFDD is employed at higher frequencies for transmissions over said shorter lines.

Preferably, an extra cyclic prefix is used for OFDD transmissions over shorter lines, and frequencies above an FDD band are not used for longer lines.

Shorter lines may be classified as lines having a length less than X metres and longer lines may be classified as lines having a length equal to, or greater than X metres, where X is a design parameter selected for a given telecommunications system.

Said cyclic prefix may be dimensioned for a shorter line.

Preferably, said cyclic prefix is dimensioned for a line of length X metres.

Time-synchronisation may be performed between all transmitters in ONUs and NTs incorporated in said system.

Timing advance may be calculated for each line from the line's length.

Different sub-carriers may be used in up-stream and down-stream transmission directions.

A power boost may be applied to FDD band transmission.

Both ADSL and VDSL may be employed.

Both ADSL and VDSL may be employed on a single wire.

The frequency band employed for FDD may be the same as that employed for ASDL in both the up-stream and down-stream transmission directions.

Said FDD band frequencies may be power boosted to the same power level as that employed for ASDL.

According to a second aspect of the present invention, there is provided, in a telecommunications system having a plurality of data modems linked to a central station by subscriber lines of differing lengths, said subscriber lines being grouped into longer and shorter lines, a method of transmitting duplex data between said central station and one, or more, modems using VDSL, characterised by using FDD for transmission at lower frequencies over said longer lines and OFDD for transmission at higher frequencies over said shorter lines.

An extra cyclic prefix may be used for OFDD transmissions over shorter lines, and frequencies above an FDD band may not be used for transmission over longer lines.

Shorter lines may be classified as those lines having a length less than X metres and longer lines may be classified as those lines having a length equal to, or greater than X metres, where X is a design parameter selected for a given telecommunications system.

Said cyclic prefix may be dimensioned for a shorter line.

Said cyclic prefix may be dimensioned for a line of length X metres.

Time-synchronisation may be performed between all transmitters in ONUs and NTs incorporated in said system.

Timing advance may be calculated for each line from the line's length.

Different sub-carriers may be used in up-stream and down-stream transmission directions.

A power boost may be applied to FDD band transmissions.

Both ADSL and VDSL may be employed.

Both ADSL and VDSL may be employed on the same wire.

The same frequency band may be employed for FDD as that employed for ASDL in both the up-stream and down-stream transmission directions.

Said FDD band frequencies may be power boosted to the same power level as that employed for ASDL.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 illustrates, in schematic form, a VDSL transmission system having long and short lines.

In order to facilitate an understanding of the present invention a glossary of terms used in the description of the present invention is provided below:

ASDL: Asymmetric Digital Subscriber Line

FDD: Frequency Divided Duplex

FEXT: Far-End Cross Talk

NEXT: Near-End Cross talk

NT: Network Termination

OFDD: Orthogonal Frequency Divided Duplex

ONU: Optical Network Unit

VDSL: Very high rate Digital Subscriber Line

As previously explained, there are two different kind of cross-talk for wire communication, cross-talk in the Near- End (NEXT) and in the Far-End (FEXT). Because NEXT is the more damaging form of cross-talk, it is more important to suppress NEXT, than FEXT. With a smart duplex scheme it is possible to minimise NEXT between VDSL Systems. The duplex method described in our patent application PCT/SE 9600935 can be used to suppress NEXT. This technique includes the following elements:

- different sub-carriers are used in the up-stream and down-stream directions;

- time synchronisation is performed between all transmitters in the ONUs and the NTs; and

- an extension of the cyclic prefix is added to compensate for propagation delay.

The present invention combines the advantages of OFDD with Frequency Divided Duplex (FDD). FDD means that the up-stream and down-stream bands are divided into separate frequency bands that can be separated with filters. For FDD, NEXT is not a problem, provided that the separate frequency bands are filtered out properly. FDD has the disadvantage that it is a static duplex scheme

and it is not, therefore, possible to change the up-stream and down-stream bands without changing filters. The advantage of OFDD is that dynamic up-stream and down-stream allocation can be employed without increasing NEXT. On the other hand, OFDD has the disadvantage that an extended cyclic prefix must be used and this becomes large for longer lines, resulting in lost capacity.

The present invention uses FDD for lower frequencies, to extend the reach without an additional capacity loss. For higher frequencies an arbitrary up-stream/down-stream loading on the different OFDD carriers makes it possible to handle different symmetry/asymmetry rates for shorter wires. To fulfil the orthogonal requirements in OFDD, an extension of the cyclic prefix has to be added. This extra prefix has to be dimensioned from the propagation delay of the longest line. This means that the capacity loss caused by the cyclic prefix becomes larger for longer lines. When the new duplex technique of the present invention is used the extra cyclic prefix is dimensioned for a shorter line. There will be no extra capacity loss for longer lines and NEXT will not be increased. The present invention requires that:

- the extra cyclic prefix be dimensioned for X metres, where X is the length of a typical shorter line; and

- for lines longer than X metres the frequencies above the FDD band are not used, i.e. FDD is used for longer lines and OFDD is used for lines less than X metres in length.

This in turn means that:

- time-synchronisation is performed between all transmitters in the ONUs and the NTs;

- timing advance is calculated from the line length; and

- different sub-carriers are used in up-stream and down-stream directions.

To further extend the reach of a VDSL system, according to the present invention, a power boost is switched on for longer lines. The power boost increases the transmitted power over the FDD band.

In Figure 1 there is shown two different line lengths with 2 groups of VDSL modems. The distance between the ONU and group 2 is less than X metres and the distance to group 1 is larger than X metres. The precise value of X is a design choice. With the new method, group 1 modems only use FDD which eliminates NEXT between group 1 modems. Group two modems can use higher frequencies, as well as lower frequencies, if the extra cyclic prefix is dimensioned for X metres. If all requirements for OFDD are fulfilled, there will be no NEXT between group 2 modems. If timing advance is calculated for each wire, then the symbols transmitted from the group 1 modems will be inside the extra cyclic prefix for the part of the wire where the two groups affect each other and the requirements for OFDD are fulfilled.

An interesting aspect of the duplex technique employed in the present invention is that co-existence problems with ADSL can be solved. The problem with mixing ADSL and VDSL on the same wire is the large NEXT from ADSL into VDSL. With the present invention it is possible to solve this problem without any NEXT between ADSL and VDSL. If we let:

- the up-stream and down-stream bands, in the FDD band, be the same as the band used in ASDL; and

- the power boost used for these bands be the same as the power levels used in ADSL,

then VDSL can offer ADSL capacity for longer lines and still offer VDSL capacity for short lines without any extra loss of capacity.

The present invention has the following advantages, it can:

- increase the capacity and the reach of VDSL systems;

- be implemented to solve the co-existence problem between ADSL and VDSL; and

- reduce the capacity loss for OFDD on long lines.

The choice of a value for X, is a design decision made for a given system. Those skilled in the art will appreciate the factors to be taken into account in selecting the value for X.

The terms "shorter" and "longer", as herein used with reference to subscriber lines, are intended to indicate the relative length of subscriber lines relative to each other, i.e. subscriber lines can be classified into two groups, depending on their length relative to each other. The question of whether a particular line is to be regarded as longer, rather than shorter is, as indicated above, a design decision. In the same way, the terms "higher" and "lower", as herein used with reference to frequency, is intended to indicate the relative values, with respect to each other, of the frequency bands employed for OFDD and FDD transmissions, i.e. the frequency band used for OFDD will be of higher frequency than the frequency band used for FDD.

For the avoidance of doubt, the term OFDD, as used in this specification, is intended to embrace similar duplex techniques, such as those employing DMT, wavelet multiplexing, or the like.

CLAIMS

1. A telecommunications system having a plurality of data modems linked to a central station by subscriber lines of differing lengths, in which duplex data is transmitted between said central station and one, or more, modems using VDSL, said subscriber lines being grouped into longer and shorter lines, characterised in that FDD is employed at lower frequencies for transmissions over said longer lines and OFDD is employed at higher frequencies for transmissions over said shorter lines.

2. A telecommunications system, as claimed in claim 2, characterised in that an extra cyclic prefix is used for OFDD transmissions over shorter lines, and in that frequencies above an FDD band are not used for longer lines.

3. A telecommunications system, as claimed in either claim 1, or claim 2, characterised in that shorter lines are classified as lines having a length less than X metres and longer lines are classified as lines having a length equal to, or greater than X metres, where X is a design parameter selected for a given telecommunications system.

4. A telecommunications system, as claimed in either claim 2, or claim 3, characterised in that said cyclic prefix is dimensioned for a shorter line.

5. A telecommunications system, as claimed in claim 3, or claim 4, when dependent on claim 2, characterised in that said cyclic prefix is dimensioned for a line of length X metres.

6. A telecommunications system, as claimed in any of claims 2 to 5, characterised in that time-synchronisation is performed between all transmitters in ONUs and NTs incorporated in said system.

7. A telecommunications system, as claimed in any of claims 2 to 6, characterised in that timing advance is calculated for each line from the line's

length.

8. A telecommunications system, as claimed in any previous claim, characterised in that different sub-carriers are used in up-stream and down-stream transmission directions.

9. A telecommunications system, as claimed in any previous claim, characterised in that a power boost is applied to FDD band transmission.

10. A telecommunications system, as claimed in any previous claim, characterised in that both ADSL and VDSL are employed.

11. A telecommunications system, as claimed in any previous claim, characterised in that both ADSL and VDSL are employed on a single wire.

12. A telecommunications system, as claimed in either claim 10, or claim 11, characterised in that the frequency band employed for FDD is the same as that employed for ASDL in both the up-stream and down-stream transmission directions.

13. A telecommunications system, as claimed in any of claims 10 to 12, characterised in that said FDD band frequencies are power boosted to the same power level as that employed for ASDL.

14. In a telecommunications system having a plurality of data modems linked to a central station by subscriber lines of differing lengths, said subscriber lines being grouped into longer and shorter lines, a method of transmitting duplex data between said central station and one, or more, modems using VDSL, characterised by using FDD for transmission at lower frequencies over said longer lines and OFDD for transmission at higher frequencies over said shorter lines.

15. A method, as claimed in claim 14, characterised by using an extra cyclic prefix for OFDD transmissions over shorter lines, and by not using frequencies above an FDD band for transmission over longer lines.

16. A method, as claimed in either claim 14, or claim 15, characterised by classifying shorter lines as those lines having a length less than X metres and longer lines as those lines having a length equal to, or greater than, X metres, where X is a design parameter selected for a given telecommunications system.

17. A method, as claimed in either claim 15, or claim 16, characterised by dimensioning said cyclic prefix for a shorter line.

18. A method, as claimed in claim 16, or claim 17 when dependent on claim 15, characterised by dimensioning said cyclic prefix for a line of length X metres.

19. A method, as claimed in any of claims 15 to 18, characterised by performing time-synchronisation between all transmitters in ONUs and NTs incorporated in said system.

20. A method, as claimed in any of claims 15 to 19, characterised by calculating timing advance for each line from the line's length.

21. A method, as claimed in any of claims 14 to 20, characterised by using different sub-carriers in up-stream and down-stream transmission directions.

22. A method, as claimed in any of claims 14 to 21, characterised by applying a power boost to FDD band transmissions.

23. A method, as claimed in any of claims 14 to 22, characterised by employing both ADSL and VDSL.

24. A method, as claimed in any of claims 14 to 22, characterised by employing both ADSL and VDSL on the same wire.

25. A method, as claimed in either claim 23, or claim 24, characterised by employing the same frequency band for FDD as that employed for ASDL in both the up-stream and down-stream transmission directions.

26. A method, as claimed in any of claims 23 to 25, characterised by power boosting said FDD band frequencies to the same power level as that employed for ASDL.

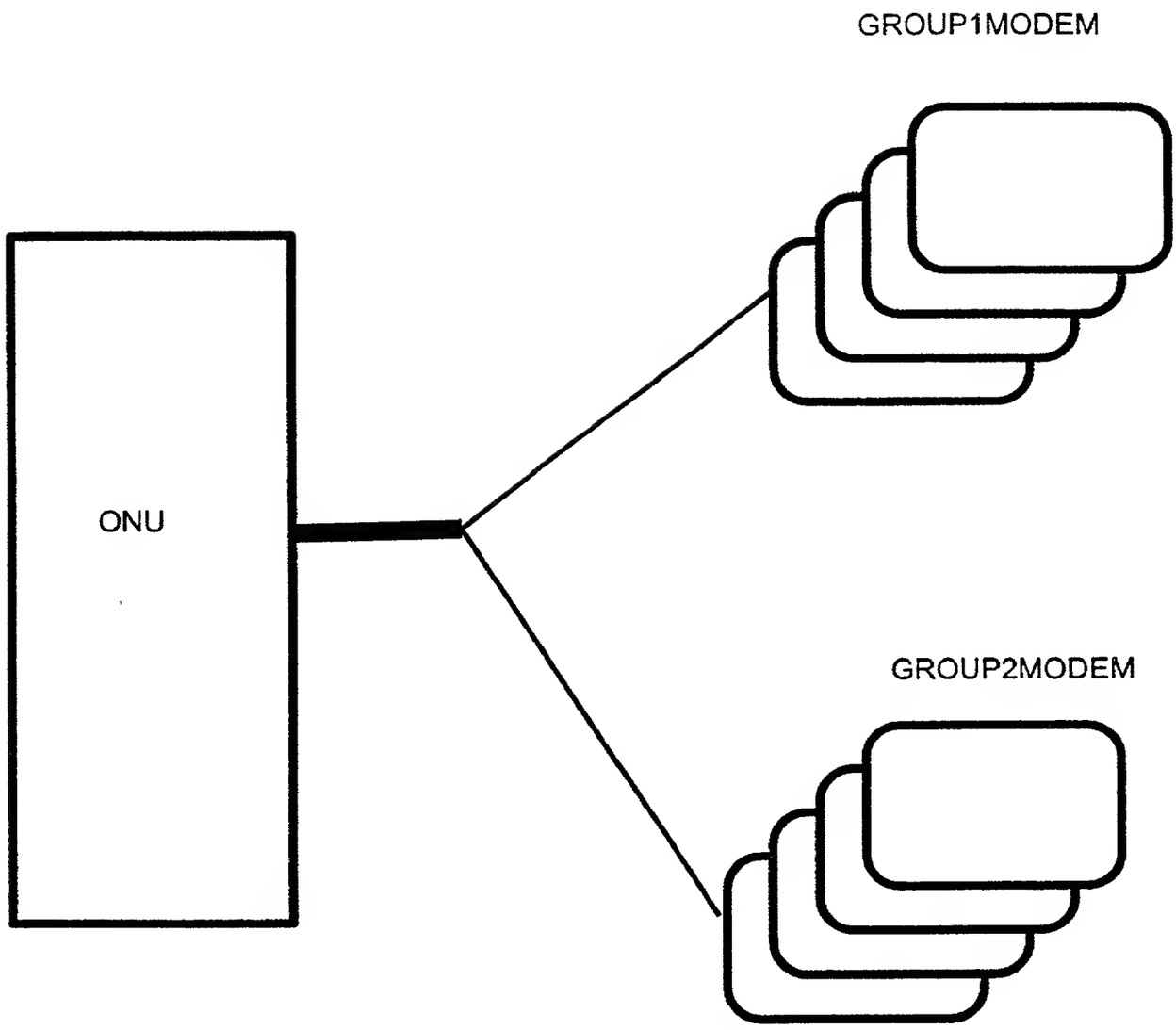

FIGURE1

2867-0187-2 PCT

Declaration, Power Of Attorney and Petition

WE (I) the undersigned inventor(s), hereby declare(s) that:

My residence, post office address and citizenship are as stated below next to my name,

We (I) believe that we are (I am) the original, first, and joint (sole) inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled

IMPROVEMENTS IN, OR RELATING TO, DIGITAL TRANSMISSION

the specification of which

☐ is attached hereto.

☒ was filed on 03 May 2000 as

Application Serial No. 09/529,429

and amended on _____.

☒ was filed as PCT international application

Number PCT/SE98/01973

on 30 October 1998,

and was amended under PCT Article 19

on _____ (if applicable).

We (I) hereby state that we (I) have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We (I) acknowledge the duty to disclose information known to be material to the patentability of this application as defined in Section 1.56 of Title 37 Code of Federal Regulations.

We (I) hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed. Prior Foreign Application(s)

Application No.	Country	Day/Month/Year	Priority Claimed
9704009-1	SWEDEN	03 November 1997	☒ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

We (I) hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

(Application Number)	(Filing Date)
(Application Number)	(Filing Date)

We (I) hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

Application Serial No.	Filing Date	Status (pending, patented, abandoned)
PCT/SE98/01973	30 October 1998	

And we (I) hereby appoint: Norman F. Oblon, Reg. No. 24,618; Marvin J. Spivak, Reg. No. 24,913; C. Irvin McClelland, Reg. No. 21,124; Gregory J. Maier, Reg. No. 25,599; Arthur I. Neustadt, Reg. No. 24,854; Richard D. Kelly, Reg. No. 27,757; James D. Hamilton, Reg. No. 28,421; Eckhard H. Kuesters, Reg. No. 28,870; Robert T. Pous, Reg. No. 29,099; Charles L. Gholz, Reg. No. 26,395; William E. Beaumont, Reg. No. 30,996; Jean-Paul Lavalleye, Reg. No. 31,451; Stephen G. Baxter, Reg. No. 32,884; Richard L. Treanor, Reg. No. 36,379; Steven P. Weihrouch, Reg. No. 32,829; John T. Goolkasian, Reg. No. 26,142; Richard L. Chinn, Reg. No. 34,305; Steven E. Lipman, Reg. No. 30,011; Carl E. Schlier, Reg. No. 34,426; James J. Kulbaski, Reg. No. 34,648; Richard A. Neifeld, Reg. No. 35,299; J. Derek Mason, Reg. No. 35,270; Surinder Sachar, Reg. No. 34,423; Christina M. Gadiano, Reg. No. 37,628; Jeffrey B. McIntyre, Reg. No. 36,867; William T. Enos, Reg. No. 33,128; Michael E. McCabe, Jr., Reg. No. 37,182; Bradley D. Lytle, Reg. No. 40,073; and Michael R. Casey, Reg. No. 40,294; our (my) attorneys, with full powers of substitution and revocation, to prosecute this application and to transact all business in the Patent Office connected therewith; and we (I) hereby request that all correspondence regarding this application be sent to the firm of OBLON, SPIVAK, McCLELLAND, MAIER & NEUSTADT, P.C., whose Post Office Address is: Fourth Floor, 1755 Jefferson Davis Highway, Arlington, Virginia 22202.

We (I) declare that all statements made herein of our (my) own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Gunnar BAHLENBERG
NAME OF FIRST SOLE INVENTOR

Signature of Inventor

30 July 2000
Date

Residence: Blidvagen 234, S-976 32
Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

200 Daniel BENGTSON
NAME OF SECOND JOINT INVENTOR

Daniel Bengtson
Signature of Inventor

2000-10-03
Date

Residence: Forskarvagen 36 A, S-977 53
Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

300 Siwert HAKANSSON
NAME OF THIRD JOINT INVENTOR

Siwert Håkansson
Signature of Inventor

2000-10-10
Date

Residence: Aprilvagen 10, S-177 61
Jarfalla, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

400 Anders ISAKSSON
NAME OF FOURTH JOINT INVENTOR

Anders Isaksson
Signature of Inventor

2000-07-31
Date

Residence: Elevvagen 1 S-977 25
Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

500 Lars-Ake ISAKSSON
NAME OF FIFTH JOINT INVENTOR

Lars-Ake Isaksson
Signature of Inventor

2000-08-07
Date

Residence: Residensgatan 6 C, S-972 36
Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

600 Mikael ISAKSSON
NAME OF SIXTH JOINT INVENTOR

Signature of Inventor

2000-08-10
Date

Residence: Borgmastarevagen 7, S-973 42 Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

700 Magnus JOHANSSON
NAME OF SEVENTH JOINT INVENTOR

Magnus Johansson
Signature of Inventor

2000-07-31
Date

Residence: Timmermansgatan 34, S-972 53 Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

800 Mauritz LAHTI
NAME OF EIGHTH JOINT INVENTOR

Signature of Inventor

2000-08-14
Date

Residence: Lingonstigen 63, S-973 33 Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

900 Lis-Marie LJUNGGREN
NAME OF NINTH JOINT INVENTOR

Signature of Inventor

2000-08-14
Date

Residence: Praktikantvagen 31, S-977 53 Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

10-00 Hans LUNDBERG
NAME OF TENTH JOINT INVENTOR

Residence: Vastra Solgatan 8, S-972 53
Lulea, SWEDEN SEX

Signature of Inventor

Citizen of: SWEDEN

Post Office Address: same as above

✓ 2000-08-10
Date

11-00 Tomas NORDSTROM
NAME OF ELEVENTH JOINT INVENTOR

Residence: Docentvagen 279, S-955 52
Lulea, SWEDEN SEX

Signature of Inventor

Citizen of: SWEDEN

Post Office Address: same as above

✓ 2000-08-28
Date

12-00 Lennart OLSSON
NAME OF TWELFTH JOINT INVENTOR

Residence: Majvagen 39, S-973 31
Lulea, SWEDEN SEX

✓ Lennart Olsson
Signature of Inventor

Citizen of: SWEDEN

Post Office Address: same as above

✓ 2000-08-07
Date

13-00 Sven-Rune OLOFSSON
NAME OF ~~XXXXXX~~ THIRTEENTH JOINT INVENTOR

Residence: Malmuddsvagen 9, S-972 46
Lulea, SWEDEN SEX

✓ SR Olof
Signature of Inventor

Citizen of: SWEDEN

Post Office Address: same as above

✓ 2000-08-14
Date

14:00 Tomas STEFANSSON
NAME OF ~~XXXXXX~~ FOURTEENTH JOINT INVENTOR

Tomas
Signature of Inventor

2000-07-31
Date

Residence: Lulavan 773, S-961 93
Boden, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

15:00 Hans OMAN
NAME OF ~~XXXXXXXX~~ FIFTEENTH JOINT INVENTOR

Hans Öhman
Signature of Inventor

2000-08-16
Date

Residence: Faltspatstigen 21, S-977 53
Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

16:00 Goran OKVIST
NAME OF ~~XXXXXXX~~ SIXTEENTH JOINT INVENTOR

G Ö L.
Signature of Inventor

2000-07-31
Date

Residence: Hagaplan 7, S-974 41
Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

17:00 Per ODLING
NAME OF ~~XXXXXX~~ SEVENTEENTH JOINT INVENTOR

Per Odling
Signature of Inventor

2000-09-25
Date

PI 6810 Lahasuad
99196 Arvidsjaur
Residence: ~~Professorsvägen 109 B,~~
~~S-977 51 Lulea, SWEDEN~~
23 October 2000 P.O.

Haidingergasse 29
A-1030 Wien
Austria

Citizen of: SWEDEN

Post Office Address: same as above

18-00 Petra DENTGEN
NAME OF ~~XXXXXX~~ EIGHTEENTH JOINT INVENTOR

Residence: ~~Docentvagen 141, S-977 52~~ * Trädgårdgatan 9c 222 53 Lund
~~Lulea~~, SWEDEN SEX
* 23 October 2000 P.D.

Citizen of: SWEDEN

Post Office Address: same as above

Peter Dentgen
Signature of Inventor

* Oct 6, 2000
Date

19-00 Frank SJOBERG
NAME OF ~~XXXXXXXXX~~ NINETEENTH JOINT INVENTOR

Residence: Forskarvagen 31 A, S-977 53
Lulea, SWEDEN SEX

Citizen of: SWEDEN

Post Office Address: same as above

* Frank Sjöberg
*Signature of Inventor

* July 31, 2000
Date

NAME OF JOINT INVENTOR

Residence:

Citizen of:

Post Office Address:

Signature of Inventor

Date

NAME OF JOINT INVENTOR

Residence:

Citizen of:

Post Office Address:

Signature of Inventor

Date